## REMARKS

This application was originally filed with Claims 1-20. Claim 21 was previously added. Claims 1, 4, 8, 9, 10, 12-16 and 18 have been rejected. Claims 5-7, 17, 19, and 20 have been objected to. Claims 2, 3, 11, and 21 have been allowed. Claim 10 has been amended. Therefore, Claims 1-21 are pending in the Application. Reconsideration of the application based on the remaining claims as amended and arguments submitted below is respectfully requested.

### Claim Rejections - 35 U.S.C. § 102(b)

Claims 1, 4, 8, 9, 12-16, and 18 have been rejected under 35 U.S.C. § 102(b) as being anticipated by Wolf, U.S. Patent No. 4,325,228. For the reasons discussed below, Applicant submits that the disclosure of the Wolf patent is not directly relevant to the claimed invention and that this rejection should be withdrawn.

The present invention is directed exclusively to geothermal heating/cooling system and specifically to a direct exchange/direct expansion geothermal heating/cooling system. Geothermal heating/cooling system designs are conventionally either water-source or direct exchange/direct expansion ("DX") heat pump systems. Water-source systems typically utilize fluid-filled (water and anti-freeze) closed loops of tubing buried in the ground, or submerged in a body of water, so as to either absorb heat from, or to reject heat into, the naturally occurring geothermal mass and/or water surrounding the buried or submerged fluid transport tubing. The water transport tubing loop is extended to the surface and is then used

to circulate either the naturally warmed or naturally cooled water to a water/refrigerant heat exchanger. The heated or cooled refrigerant is then used to heat or cool the interior air using an interior air/refrigerant heat exchanger. Such a heat exchanger will include a separate and independent refrigerant circuitry loop. Conventional, older geothermal water-source heating/cooling systems typically circulate, via a water pump, a fluid (water or water with antifreeze) in plastic underground geothermal tubing to transfer heat to or from the ground in a first heat exchange step. In a second heat exchange step, such systems use a separate and secondary refrigerant loop to transfer heat to or from the separate and primary water loop. In a third heat exchange step, an electric fan transfers heat to or from the interior air from or to the refrigerant that is circulating within finned tubing. The air moving across the finned tubing is used to heat or cool the interior space.

In a DX system, refrigerant transport lines, usually made of copper, are placed directly in the sub-surface ground or water. The refrigerant lines typically circulate a refrigerant fluid (e.g., R-22). Thus, in a first heat exchange step, heat is transferred to or from the sub-surface elements. Above the surface, the refrigerant lines are connected to finned refrigerant tubing. The DX system then requires only a second heat exchange step to transfer heat to or from the finned refrigerant tubing from the interior air space by blowing a fan across the finned tubing. Consequently, DX systems are generally more efficient than water-source systems because they use fewer heat exchange steps. The refrigerant fluid circulating within the copper tubing of a DX system has a greater temperature differential with

the surrounding ground or water as compared to a water-source system. A DX system also has the advantage of effecting a sub-surface phase change thermal transfer, something that does not occur in a water-source system. Accordingly, the DX system requires less drilling and excavation than does a water-source system.

The heat pump system components disclosed in Wolf are those of a conventional water-source heat pump. Wolf refers to this as a "liquid-to-air heat pump" in col. 3, line 34. Wolf further discloses a heat pump refrigerant transport loop that is totally above ground, which is typical for a water-source system. (Col. 3, lines 33-46) The heat exchanger 23 in Wolf operates as an evaporator (col. 3, lines 51-52). The heat exchanger 23 also functions as a condenser. (See col. 4, lines 12-13). Again, this is typical of a water-source system. Notably, the heat exchanger 23 in Wolf is not in the ground itself, as it would be if it were a DX system as in the present invention. Rather, heat exchanger 23 is a refrigerant-to-water heat exchanger that is common to all water-source systems that effect sub-surface heat transfer by circulating the water underground using one or more water pumps (31 and 33 in Wolf). The water circulating underground in a closed-loop water-source system like that of Wolf is always in a heat exchange relationship with the refrigerant of the separate refrigerant loop circuitry via a water-to-refrigerant heat exchanger. The water-to-refrigerant heat exchanger is typically formed by wrapping the refrigerant loop around the water loop, with the water loop extending to a sub-surface heat exchanger. Such a configuration is, in fact, used by Wolf. (See col. 4, lines 31-47.) The essence of Wolf's design has nothing at all to do with a DX

system, or even with a heat pump refrigerant circuitry design, but, rather, concerns an allegedly improved means to effect sub-surface heat transfer via the sub-surface water loop circuitry in a water-source heat pump system (see Wolf, column 2, lines 28-42).

In the present invention, the claimed auxiliary refrigerant pump is not a common liquid water pump (as in Wolf's pumps 31 and 33), but, rather, is a specialized refrigerant fluid pump, capable of pumping a liquid refrigerant in the cooling mode of operation (when the ground itself is the condenser) and a vapor (when the ground itself is an evaporator) so as to take the refrigerant head pressure off the DX system's refrigerant compressor in a deep well DX system application. There is never any unbalanced sub-surface heat exchange fluid flow head pressure in the Wolf design (as there always is in the present design), because a water-source system does not incorporate a sub-surface fluid phase change in any operational mode, and because the distance the liquid water travels up to the water-to-refrigerant heat exchanger (23 in Wolf) is always equally offset by the downward liquid water head pressure.

The use of a supplemental refrigerant fluid pump would virtually never occur to anyone designing a water-source heat pump system. There would be no need for such a pump because the refrigerant loop is always relatively condensed in area and never needs to operate at significant depths. Further, the water pumps (31 and 33 in Wolf) used in a water-source heat pump system is not designed to take any head pressure off the compressor, or off anything else, as it is only used to circulate water

and generally only needs to account for the wall resistance factors of the water loop containment tubing. The water circulation pump in a water-source heat pump system and a supplemental refrigerant fluid pump in the actual refrigeration loop of a DX heat pump system are entirely different pieces of equipment with entirely different purposes. For example, a liquid water circulation pump typically needs to pump about 8 gallons of water per minute per ton of system design capacity, with excess pumping rates being of little consequence. A supplemental refrigerant fluid pump in a DX system as claimed herein must be designed to offset the head pressure in the cooling mode while virtually almost exactly matching the design refrigerant flow rate of the compressor.

In summary, each of the claims rejected as being anticipated by Wolf requires an auxiliary refrigerant pump. Wolf does not disclose such a pump because Wolf pertains to a water-source geothermal heat pump system, not a DX system. The "auxiliary liquid circulating pump" 31 cited in the Office Action is a water pump, not a refrigerant pump as claimed. Therefore, the rejection of Claims 1, 4, 8, 9, 12-16, and 18 should be withdrawn.

<u>Claim Rejections - 35 U.S.C. § 103</u>

Claim 10 has been rejected under 35 U.S.C. § 103(a) as being unpatentable over Wolf in view of "Official Notice." Claim 10 (being dependent on Claim 1) also requires an auxiliary refrigerant pump that is not taught by Wolf. (See discussion above.) The claimed invention in general is a DX geothermal heat pump system. The discussion

above demonstrates that, with respect to the use of an auxiliary refrigerant pump, a DX system is materially different from the water-source system of Wolf. Accordingly, even the combination of Wolf and the Official Notice taken in the Office Action does not teach the invention of Claim 10.

With specific regard to the oil separator referenced in Claim 10, it is well known that an oil separator can be used to remove oil from the refrigerant and to distribute that oil back to the compressor. However, Wolf did not incorporate an oil separator in his heat pump design because, prior to the present invention, the geothermal industry (both water-source and DX) generally has not done so because it has not been needed. Typically, enough oil is originally provided in the compressor itself so as to accommodate an adequate oil return to the compressor in most all near-surface heat pump systems, whether an air-source heat pump, a geothermal water-source heat pump, or a geothermal DX system heat pump, without the necessity and expense of adding an oil separator. The present invention for the first time introduces a DX system that can efficiently operate in a reverse-cycle mode at depths in excess of 100 feet. This functionality is enabled by the use of the auxiliary refrigerant pump and, in some embodiments, an oil separator. Claim 10, as amended, specifies that the oil separator connected to the compressor. Although the Examiner is generally correct that oil separators are used to remove oil from a refrigerant, the general case is not applicable here. In the prior art, the oil separator is employed to prevent oil from traveling to and coating the heat exchanger tubing, where the oil coating will inhibit thermal transfer and/or

the oil separator is not connected to the compressor. In the present invention, the oil separator is connected to the compressor to prevent the loss of any oil into other system component parts, and also functions to prevent a pooling of oil at the bottom of a deep well (in excess of 100 feet deep) heat exchanger tubing. In other words, the motivation to use an oil separator comes from the novelty of the invention itself. Such motivation is not found in the prior art.

For the foregoing reasons, the rejection of Claim 10 under §103 should be withdrawn.

Allowable Subject Matter

Claims 2, 3, 11, and 21 have been allowed. The Examiner has objected to Claims 5-7, 17, 19, and 20 as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form to include all of the limitations of the base claim and any intervening claims. Claims 5-7, 17, 19, and 20 are dependent on claims that are allowable over the art of record, as demonstrated by the discussion above.

Applicant has commented on some of the distinctions between the cited references and the claims to facilitate a better understanding of the present invention. This discussion is not exhaustive of the facets of the invention, and Applicant hereby reserves the right to present additional distinctions as appropriate. Furthermore, while these remarks may employ shortened, more specific, or variant descriptions of some of the claim language, Applicant respectfully notes that these remarks are not to

be used to create implied limitations in the claims and only the actual wording of the claims should be considered against these references.

The Commissioner is authorized to charge any deficiency or credit any overpayment associated with the filing of this Response to Deposit Account 23-0035.

Respectfully submitted,

Mark J. Patterson
Registration No. 30,412
WADDEY & PATTERSON
A Professional Corporation
Customer No. 23456

ATTORNEY FOR APPLICANT

CERTIFICATE OF FIRST CLASS MAILING

I hereby certify that this Response and Amendment, including a check in the amount of $490.00 are being deposited with the United States Postal Service as first class mail in an envelope addressed to:

Mail Stop Fee Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

on December 7, 2004.

Mark J. Patterson
Registration Number 30,412

12/7/2004

Date